

to be reduced. There is lot of new technology in the nuclear area, and I will tell you that some who have been stout opponents of nuclear, when they are considering a likely alternative in an energy-deficient world of shivering in the dark, nuclear is looking better to them.

Nuclear fusion. That is the only energy source out there that is a silver bullet. If we find that, we are home free. By the way, we have a great fusion reactor. It is called the Sun. And the Sun is the source of almost all the energy we use. It was the shining of the Sun a long while ago that produced the plants that produced the gas, oil, and coal. It is the shining of the Sun that produces the differential temperatures and makes the winds blow. It is the sunshine that lifts the water from the ocean and the plains and drops it on the mountains and it flows down through the dams to produce hydropower. There are only a few sources of power that don't come from the Sun: nuclear, a trifling amount of chemical, and the tides don't come from the Sun.

By the way, there is a huge potential amount of energy in the oceans, but it is so disbursed that it is just hard to collar it. There is an old axiom that says that energy or power to be effective must be concentrated. Look at the tides. The Moon lifts the oceans 2 or 3 feet. I carry two 5-gallon buckets of water, and that is heavy. How much energy would it take to lift the whole ocean, 75 percent of the world's surface, 2 or 3 feet? But the problem is harnessing that energy.

But there are other potential ocean energy sources, like the ocean thermal gradients. In the tropics, it is very warm on the surface and very cold on the bottom. And there are several technologies for getting energy from that temperature difference.

Then we get to the true renewables. By the way, there are many people who don't really think it is necessary to talk about this because they are market enthusiasts, and they will tell you that the market will solve this problem. The market will solve this problem. You may not like the way that the market will solve this problem because the price of oil, unless we do something and move aggressively towards alternatives, may go really high. I hear people telling me gas may go to \$20 or \$25 a gallon in an energy-deficient world. So the market will solve the problem, but you may not like the way the market solves the problem.

There are two problems. One is that the resources are not infinite and they are not available in the time in which the market would like to have them. The second problem is that the market signals are not timely enough.

One of the big studies done, our government, your government, has paid for four studies. They are ignoring all of them. The first one, the Hirsch Report, said that the world has never faced a problem like this, and challenges us to plan for this a couple of

decades ahead because they said if you haven't started to plan for this two decades ahead, there will be some economic consequences. If it is only a decade ahead, there will be big economic problems. And if you wait until it is upon you, and apparently it is, they said the world has never faced a problem like this. There is no precedent in history.

The next chart shows those things in an interesting form. I would like to use analogy for this chart, and that is, the young couple whose grandparents have left them a big inheritance and they have a lavish lifestyle where 85 percent of the money they spend comes from their grandparents' inheritance and 15 percent is from their income. They look at the inheritance and it is going to run out a long time before they retire at the rate they are spending it. So they have to either make more or spend less.

Here we are: 85 percent of all of our energy comes from coal, gas, and petroleum, the oil. So 15 percent is left. A bit more than half of that is nuclear electric power, and the rest is renewables. Now, some people have it 86-14, but it is roughly 85-15. Notice the breakout here of the renewables. In 2000, solar was 0.07 percent. So maybe it is 10 times bigger. That is still a tiny, tiny amount.

Wood. That is the timber industry and the paper industry wisely burning what would otherwise be a waste product, filling up landfills.

Waste energy. That is a great idea, a whole lot better than putting it in a landfill. We ought to recycle what we can productively recycle and then burn the rest of it. And there is a great facility in Montgomery County, and it is really a class facility. I wouldn't mind having it next to my church. It is a great-looking building. You don't see or smell the trash, and it is producing electricity. But that is not a solution to our energy problem because most of the trash that they are burning is the consequence of profligate use of fossil fuel energy. And in a fossil fuel-deficient world, that trash stream is going to be very much less. So for the moment that is a good idea, but it is not a solution to our problem.

Wind. Wind is the most rapidly growing alternative today. The leading country in that is Denmark. They produce electricity at a cent and a half a kilowatt hour. We can do it here for 2.5 or so cents a kilowatt hour.

Conventional hydro. We are tapped out on that, probably. Some believe we can get as much hydro from what is called microhydro. It is much less environmentally threatening, small devices in streams to produce electricity.

Alcohol fuel. I have just a moment to spend on that. The National Academy of Sciences says that if we turn all of our corn into ethanol, all of it, and discount it for fossil fuel input, that it would displace 2.4 percent of our gasoline. This is not ROSCOE BARTLETT saying that; this is the National Academy

of Sciences. They noted if you tuned up your car and put air in the tires, you could save as much energy as you would get from all of our corn converted to ethanol. We haven't converted it all, but the amount that we have converted has doubled the price of corn. And our farmers diverted land from wheat and soybeans to corn, and there was an increased demand for wheat and soybeans, so now the price of all three, for these major foods, for poor people around the world is up.

In fact, a member of the United Nations said what we had innocently done, inadvertently done, unintended consequences, was a crime against humanity because now three of the basic four foodstuffs in the world, rice, corn, wheat and soybeans, have increased in price because we had this government-subsidized corn ethanol program.

We will get something from biomass, from cellulosic ethanol, something from corn. But Hyman Rickover cautioned wisely in his speech 51 years ago, you should be careful eating your food. He also said you should be careful you don't burn up the fertility of your soil by removing the organic material which produces what we call tilth, which is what makes the difference between topsoil and subsoil. It holds nutrients and water. We will get something from these. I think now there is an irrational exuberance, as was said about the market a few years ago. We will get something, but it is not a silver bullet. It will not be a huge amount. And we use so much oil, it will barely make a dent in it.

Geothermal. That is true geothermal, tapping the molten core of the Earth. That is one source of energy that didn't come from the Sun. We need to exploit that more. That is not tying your air conditioner, your heat pump to ground temperature, which is a great idea. In the summertime to cool your house, you are trying to heat up that 100-degree air outside. It is easier to heat up the ground at 56 degrees. In the winter, you are doing the opposite.

The next chart looks at coal. This assumes 250 years. If you grow only 2 percent, and I think we will need to dip into our coal more than 2 percent, if we have less and less oil, it shrinks to 85 years. If you use some of the energy from the coal to produce a gas or a liquid, and it is not fair to make the comparison if you don't, then it shrinks to 50 years.

Now another interesting phenomenon here, which is unavoidable, we are going to have to share that with the world because if we use the oil that we produce from coal, then the oil we might have used someone else will use. So in effect you are sharing it with the world. So now 12 divided by 4, we use a fourth of the oil, is 12.5 years. It is even less if it is only 100 years, maybe 6 years or so.

The next chart is a great example of efficiency. This shows producing light from the incandescent bulb, the fluorescent, and the light-emitting diode.